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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/047,610	01/16/2002	Carl P. Babcock	039153-0325	5742

7590 09/08/2004

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EXAMINER	
ROSASCO, STEPHEN D	
ART UNIT	PAPER NUMBER
1756	

DATE MAILED: 09/08/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/047,610	BABCOCK ET AL.	
	Examiner	Art Unit	
	Stephen Rosasco	1756	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *15 June 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-22* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *15-22* is/are allowed.

6)☒ Claim(s) *1-14* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

Detailed Action

In response to the Appeal Brief filed 6/15/04, the examiner here reopens prosecution, and includes new rejections based on newly cited art. Claims 1-14 are rejected over 35 U.S.C. 102(b), 35 U.S.C. 103(a) and Obvious Double Patenting over Kim 6,593,039.

Claims 15-22 are allowed.

REMARKS :

(Claims 1-14)

The applicant argues that while the cited prior art to Tanaka et al. and Kawano et al. does disclose opening patterns etched to different depths (see Figure 3E), it does not identically disclose a mask that includes trenches having different depths such that light of a first wavelength may be phase-shifted utilizing trenches) having a first depth and light of a second wavelength may be phase-shifted utilizing trenches) having a second depth.

The pending claims are drawn to an article of manufacture, i.e., a phase shifting mask. The claimed limitation that the mask is to be used with two different wavelengths is not a limitation on the structure of the mask, and therefore, does not further limit the claim and is considered a statement of intended use. Therefore, this statement of intended use or arguments that are directed to the use of the mask, cannot be given any weight in determination of patentability.

The applicant also discusses the Pierrat et al. reference, with respect to the fact that though the reference teaches the use of exposure with two different wavelengths it also teaches that the trenches are of the same depth. The applicant also cites a calculation from the reference to show that it is specific to a single trench depth.

This patent is cited to show the phase shifting of two different wavelengths in one mask using trenches made to a controlled depth to shift the two different wavelengths by a precise amount; and to show that it is not readily obvious how this can be done. In the claimed invention the use of two different wavelengths does not place any additional burden on the design of the trenches. The wavelength and shift function independently for each trench, which are in different regions of the mask.

The prior art obviously shows the relationship between exposure wavelength and depth of trench. And that a second trench with a different depth can be used to make a relative phase shift between the first and second trench, analogous to the shift from the surface and a first trench depth; and that a mask with a trench designed for phase shifting can be used with two different wavelengths, if the wavelengths were selected appropriately.

The examiner maintains the rejection on the grounds that the prior art amply demonstrates all of the features of the claimed invention and there function in the mask art, that the prior art has shown the use of two different wavelengths of light together in the one mask and that the use of a second trench for phase shifting a second wavelength of light is a repetition of the first trench for the same purpose.

Claims 6 and 7 address the coverage of the surface area of one side. The coverage of the surface is readily controlled in the method of making the mask, and it would certainly be obvious to one to design the mask with coverage to any desired extent.

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-6, 9-11and 14 are rejected under 35 U.S.C. 102(b) as being clearly anticipated by Kawano et al. (6,159,642) or Tanaka et al. (5,549,995).

Kawano et al. teach an exposure mask comprising: a transparent substrate having a light shielding pattern and an aperture pattern thereon for transmitting exposure light;

wherein said transparent substrate is arranged such that two adjacent apertures of the aperture pattern having a same aperture pattern width W1 have respective first and second trenches having first and second depths of D1 and D2, respectively, the second depth D2 being deeper than the first depth D1; and

a difference between the aperture pattern width W1 and an adjacent light shielding pattern width W2, and the first and second depths D1 and D2 are calculated as an optimal solution in a simulation method to make a value of a depth of focus a maximum when a sum of the aperture pattern width and the adjacent light shielding pattern width W2, which is determined by a design rule, is given.

And wherein the difference between the aperture pattern width W1 and the adjacent light shielding pattern width W1 and the first and second depths D1 and D2 are calculated by using a coherence factor during exposure, a complex index of refraction of the transparent substrate at a wavelength of the exposure light, and a complex index of refraction of the light shielding pattern at the wavelength of the exposure light as an initial condition when the sum of the aperture pattern width W1 and the adjacent light shielding pattern width W2 is given.

Tanaka et al. teach a method of manufacturing a transmitting photomask, includes a step of forming a plurality of transmitting portions including recesses having different depths alternately by etching the transparent substrate through the opening patterns by use of anisotropic etching.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Pierrat et al. (6,068,951) or Ito et al. (5,700,605) in view of Tanaka et al. (5,549,995).

The claimed invention is directed to:

Claims 1-8, phase shifting mask comprising a transparent material having a plurality of first and second trenches which are a different depth.

Claims 9-14, wherein the trenches are produced by etching the substrate.

Pierrat et al. teach a phase shifting mask formed from a quartz substrate including a phase shifting layer etched into a surface of said substrate for shifting a first exposure light having a first wavelength about 180 degrees and shifting a second exposure light having a second wavelength about 180 degrees.

Ito et al. teach in a method for production of a mask for light exposure provided with a light transparent substrate and a mask pattern formed on the light transparent substrate, said mask pattern comprising a light screening pattern composed of a material which screens the exposure light and transmits the light having the longer wavelength than that of the exposure light and a phase shift pattern formed by engraving a part of the light transparent substrate, said process comprising calculating an etched depth of the light transparent substrate by determining the optical image of the light passing through the light screening pattern and the light passing through an opening of the light screening pattern or determining the phase difference between

said two kinds of lights using the phase measuring light having the longer wavelength than that of the exposure light.

The teachings of Pierrat et al. or Ito et al. differ from those of the applicant in that the applicant teaches having a plurality of first and second trenches formed in the substrate, which are a different depth.

Tanaka et al. teach a method of manufacturing a transmitting photomask, includes a step of forming a plurality of transmitting portions including recesses having different depths alternately by etching the transparent substrate through the opening patterns by use of anisotropic etching.

It would have been obvious to one having ordinary skill in the art to take the teachings of Pierrat et al. or Ito et al. and combine them with the teachings of Tanaka et al. in order to make the claimed invention because it is well known in the phase shifting mask art that the depth of trench can be adjusted to transmit light that is shifted by a desired amount.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-14 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-20 of U.S. Patent No. 6,593,039 in view of Tanaka (5,549,995).

Kim teaches that various different wavelengths of light are used in different photolithographic processes. The optimal wavelength of light is based on many factors and must be determined by performing a lithography test with photolithographic equipment having

different wavelengths. When a phase shifting mask technique is utilized, two different phase shifting masks must be fabricated, each mask having trenches 16 suitable for phase shifting light of the desired wavelength. The fabrication of phase shifting masks is costly. Further, comparison of the effect of the two different wavelengths printing processes is difficult and requires complex software processing to provide a suitable display.

And further in an exemplary embodiment, trenches 26 are configured to have a depth, which provides a 180 degree phase shifting effect. Generally, the depth of trenches 26 depends on the wavelength of light being used. As discussed, phase shifting masks can be utilized to improve mask resolution and depth of focus by phase shifting light at certain portions such that the light waves passing through the mask interfere constructively instead of destructively with proximate or adjacent transmitted light.

In the teachings of Kim the mask can include a first portion and a second portion. The first portion has a phase shifting material layer and an opaque layer deposed over a transparent layer, where the first portion has trenches in the transparent layer selectively located to provide an alternating phase shifting characteristic. The second portion has the opaque layer deposed over the phase shifting material layer, which is deposed over the transparent layer.

The teachings of Kim differ from those of the applicant in that the applicant teaches the use of two trench depths to be used for shifting light of the two different wavelengths.

Tanaka et al. teach a method of manufacturing a transmitting photomask, includes a step of forming a plurality of transmitting portions including recesses having different depths alternately by etching the transparent substrate through the opening patterns by use of anisotropic etching.

It would have been obvious to one having ordinary skill in the art to take the teachings of Kim and combine them with the teachings of Tanaka et al. in order to make the claimed

invention because the shift performed on the incident light is a function of the relative difference in optical transmission path between the shifted and non-shifted light, the use of one trench depth in conjunction with the surface of the substrate would give the same relative shift as that between two different trench depths having the same difference in optical path length.

Conclusion

Any inquiry concerning this communication or earlier communications from the Examiner should be directed to Stephen Rosasco whose telephone number is (571) 272-1389. The Examiner can normally be reached Monday-Friday, from 8:00 AM to 4:30 PM. The Examiner's supervisor, Mark Huff, can be reached on (571) 272-1385. The fax phone number for the organization where this application or proceeding is assigned is (703) 872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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8/25/04